BEFORE THE ENVIRONMENTAL PROTECTION AUTHORITY

AT WELLINGTON

IN THE MATTER	of the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012
AND	
IN THE MATTER	of a decision-making committee appointed to hear a marine consent application by Trans Tasman Resources Limited to undertake iron ore extraction and processing operations offshore in the South Taranaki Bight

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CORPORATE EVIDENCE OF MATTHEW EARLE DUNLOP BROWN ON BEHALF OF TRANS TASMAN RESOURCES LIMITED

16 DECEMBER 2016

ATKINS | HOLM | MAJUREY

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INTRODUCTION

Qualifications and experience

1. My name is Matthew Earle Dunlop Brown.

2. I am the General Manager of Exploration for Trans-Tasman Resources Limited (TTR). I hold the degrees of Bachelor and Master of Science from the University of Auckland. I have over 17 years' experience in the mineral extractive industry within New Zealand. I am also a member of the Australasian Institute of Mining and Metallurgy (AusIMM).

3. My role for TTR involves the management and overview of the technical surveys and investigations undertaken within TTR's mineral permit and licence areas. The role also entails providing technical support across the company and working closely with other disciplines within TTR, such as engineering and environmental.

SCOPE OF EVIDENCE

4. The scope of my evidence is to demonstrate the robust and extensive investigations TTR have undertaken to determine the nature and extent of the offshore iron sand resource.

5. My evidence will outline the following:

    (a) Iron sand mineral resource;

    (b) TTR's investigations of the offshore iron sand resource, including:

        i. Airbourne magnetic survey;

        ii. Offshore drilling activities;

        iii. Seismic surveys;

    (c) Metallurgical studies to determine the properties of the iron sand resource;

(d) Mineral resource estimation work to understand the extent, grade and occurrence of the iron sand mineral resource; and

(e) Proposed geotechnical operations.

6. TTR uses New Zealand based external accredited laboratories[1] to undertake the sample analysis to ensure quality control. Resource modelling and mine scheduling has been completed by an external consultant to ensure industry best practice has been followed.[2]

IRON SAND MINERAL RESOURCE

7. Iron sands are comprised principally of silica sand with dark green clinopyroxene, black orthopyroxenes, hornblende (all are silicate minerals) and titano-magnetite. In addition to the sands the samples commonly contain up to 15% shells and pebbles.

8. The nature, extent and provenance of New Zealand's iron sand deposits (both offshore and onshore) have been researched and investigated since the 1960s.

9. Since discovery of the offshore iron sands in the early 1960s, a general understanding of the iron sand concentrations and distribution has been obtained through surface seabed sampling. A founding study investigating the extent of the offshore iron sand resources along the west coast of the North Island was undertaken in 1980 by Professor Lionel Carter[3] (Victoria University). Professor Carter compiled maps that showed the broad regional distribution of iron sand

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1 TTR use SpectraChem Group, part of CRL Energy Limited to undertake sample analysis.

2 TTR use Golder Associates and Resource Evaluation Services to undertake the mineral resource estimation.

3 Iron sand in continental shelf sediments off western New Zealand – a synopsis. New Zealand Journal of Geology and Geophysics, 23:4 455 – 468.

concentration and seabed sediments off Auckland, Taranaki and Wanganui, based on surface seabed samples.

10. Based on the investigations I outline below, my view is that the offshore iron sand resource in the South Taranaki is very similar if not identical to that of the onshore iron sand resources along the west coast of the North Island.

TTR'S INVESTIGATIONS OF THE OFFSHORE IRON SAND RESOURCE

Airborne magnetic survey

11. During 2010 and 2011 Fugro Airborne Services was commissioned by TTR to undertake an extensive airborne magnetic survey over offshore areas held under prospecting permits, both within the STB and offshore Waikato.

12. The STB data clearly showed magnetic features (an indication of magnetic iron sand concentrations), such as old river channels, river mouths, beach dune deposits and possibly river deltas. From this data it was interpreted that during the period of low sea levels, ancient river channel and river mouth systems were the locality for iron sand concentration. TTR then undertook multiple drilling programmes to confirm the occurrence, depth, concentration and extent of the iron sand in these areas.

Drilling

13. TTR investigated various types of offshore drilling methods and technology before deciding to purposely design, construct and develop its own proprietary drilling technology. This has been done in co-operation with a Wellington based, experienced offshore drilling contractor (New Zealand Dive and Salvage), and a New Zealand based drilling contractor (Cooper Drilling Services). TTR has developed two different submersible rigs which are used

depending on the number of holes required, water depth, and desired target depth.

14. TTR's main, and extensively used, drilling rig (the shallow drilling rig) utilises air and water to slurry the sediment instead of using a mechanical cutting head to collect representative samples from below the seabed. The drilling system is a single pass drilling system, with the sampling rod only going through the sediment once, so the maximum penetration depth is up to 11m below the seafloor.

15. The slurried sediment is then transported to the surface onto the vessel and the entire sample is collected.

16. The shallow drilling rig is operated remotely from a vessel using an electric and hydraulic system. Once winched down onto the seabed a hydraulic ram is used to control the penetration of the drill sampling rod into the sub surface sediment, and again to pull the drill string from the hole. The whole process is monitored by two cameras stationed on the rig.

17. This rig is fast, cost-effective on a shallow resource, has minimum impact of the seabed and can drill up to eight holes to 11m depths within a 12 hour day.

18. TTR has also undertaken drilling using a vibrocorer. This enabled TTR to collect drill cores.

Seismic surveys

19. In 2011 and 2012 TTR commissioned the National Institute of Water and Atmospheric Research Limited (NIWA) to undertake 2D seismic surveys within the South Taranaki Bight, including the proposed mining area.

20. This high resolution seismic surveying provided valuable geological information of the sub seafloor, the geometry of the sedimentary units and their spatial extent.

21. From the above investigations, TTR has gained a very good understanding of the sub-seafloor geology within STB.

Other technical studies

22. TTR has undertaken a number of studies on the marine sediment extracted via drilling to understand its physical and chemical properties.

23. Since beginning testing in 2009 TTR has progressively built a good understanding of the properties of the marine sediment and the run of mine material to be processed by the Integrated Mining Vessel. Testing included:

    (a) Particle Size Distribution (PSD) (physical sizing and laser sizing);

    (b) Chemical Assays (XRF, major oxides and trace elements);

    (c) Beneficiation testing to determine equipment specifications;

    (d) Density (specific gravity, bulk density);

    (e) Materials handling properties (angle of repose, moisture limits etc.); and

    (f) Geotechnical drilling.

24. The results of the above test work have been used to estimate the iron sand resource as well as to provide inputs to environmental models and engineering studies.

Run of mine sediment characteristics

25. Detailed analysis of the drill samples have been undertaken by TTR to determine the chemical composition, density and physical properties of the sediment to be mined.

26. All drill samples are analysed using X-ray fluorescence (XRF) which is used to determine the elemental composition of the sample. This provides an in-situ measurement of the elements that will be expected during mining (run of mine sediment). TTR have had over 1,000 samples analysed using XRF within the proposed mining area alone. Within the greater STB area TTR have had over 4,200 drill samples analysed by XRF.

27. Additional testing on selected drill samples included the testing of particle density, bulk density, the magnetic proportion of the sample and the particle size distribution of the drill samples.

28. The particle size of the run of mine has been determined by the analysis of 105 samples from 10 locations within the proposed mining area. TTR have sampled to the full depth (11m) of the proposed mining depths of these areas.

29. The run of mine sediment characteristics has been determined by drilling and bulk sampling of sediment from within the project area. TTR has undertaken bulk testing of over 14 samples from various locations within the proposed project area.

30. Bulk sampling has enabled TTR to conduct larger scale "pilot plant" testing of the run of mine sediment to optimise the processing required to produce a consistent iron sand concentrate.

Mineral resource estimation

31. TTR has undertaken and updated the resource estimations of the offshore iron sand resource within the application area as well as adjacent areas since 2009. The resource estimation is updated once a new program of drilling has been completed. Resource modeling uses interpolation techniques to estimate grades for points between the known

data points (which are determined by drill samples), within geologically defined volumes.

32. The modelling was undertaken in conjunction with an external consultant, to provide third party verification of the inputs and the result. This has provided TTR with the confidence to develop a preliminary mine schedule.

33. TTR has reported the iron sand resource estimates to the JORC (Joint Ore Reserves Committee) 2012 code. JORC is the Australasian code for reporting mineral deposits and sets the standards, recommendations and guidelines for the public reporting of exploration results, mineral resources and ore reserves. TTR's mineral estimation has been completed under strict practices to ensure the transparency, materiality and competence of the resource estimation.

34. TTR has reported within the STB titano-magnetite Resource Estimates (JORC 2012) for the Mine Area, the mineral Resource Estimates for STB Area 2 (which covers a larger area within he STB) and reported an Exploration Target for the South Waikato project area.

35. STB mineral resource estimates are as follows:

STB Mineral Resource Estimates	**Head Grade**			**Concentrate**	
	Cut-Off Grade	**Mt**	**Fe_2O_3%**	**Mt**	**Fe%**
Area 2 Outside Mine Area	7.5% Fe_2O_3	2,137	9.66		
Mineral Resource Mine Area	3.5% DTR*	1,043	11.28	75	56.31
Kupe Blocks	3.5% DTR*	655	10.97	45	56.73

* DTR is Davis Tube Recovery the magnetic fraction of the sample.

36. TTR's STB reported resources for the project area will support mining operations at the proposed extraction rate of up to 5Mt ore per annum for 20 years.

37. TTR's reported resources in Area 2 and the Kupe Block represent a further 40 to 50 years of potential mineable resource.

MINE SCHEDULING

38. TTR commissioned an international mining consultancy to undertake the initial mine scheduling to determine the optimal mining sequence within the project area. The mining schedule is a dynamic process and has scheduling parameters related to the use of the remote crawler operations and the integrated mining vessel. These factors include optimal block dimensions, grade of the mining block, orientation of the integrated mining vessel, plant constraints as well as time in use models to ensure a realistic schedule is obtained.

39. Mining schedules can be adjusted and updated before and during mining operations as required to address any changes that operations encounter from either grade control drilling and or actual mining activities. The ability to change and adjust the mining schedules as and when required is a relatively simple exercise once the scheduling model has been set up.

40. The schedule is based on the resource model (previously described) whereby the crawler will extract from the base of the predetermined defined "orebody" (further defined by grade control drilling) and will then cut the full depth face (up to 11 metres deep) during the scheduling sequence.

41. Single pass mining and the technology of the crawler enables TTR to provide controlled extraction and ensure that

the iron sand resource is mined efficiently with minimal waste i.e. we do not unnecessarily leave mineable sediment.

42. The crawler dredge unit will mine the 300m x 300m wide panels in 'lanes' with a 1m overlap on each side to ensure potential ore losses are minimised. Vertical control of the crawler is achieved through a combination of sonar and positional monitoring equipment. The mining panel dimension assists in minimising the anchor movements of the Integrated Mining Vessel.

43. For the remote crawler, mining panels or blocks are generally aligned parallel to the SW - NE wave and wind direction for the area. This is currently the preferred alignment for directional control of the Integrated Mining Vessel and the preferred alignment of the remote crawler advance direction to minimise the de-ored sediment onto the unmined areas.

GRADE CONTROL DRILLING

44. The purpose of grade control drilling is to understand and document any variability in sampling and the ore reserve, prior to the mining of the scheduled mining area or block. This is an ongoing process which takes place ahead of the mining operations and allows for adjustments of mining schedules and mineral grade projections.

45. The grade of an ore body and the mineral being mined is never constant and with grade control drilling this helps to define material changes that could affect mining operations and the processing plant. Grade control drilling is the final step for geologists in defining the ore body boundaries, lithology changes and the grade/tonnage before extraction takes place.

46. The actual spacing of the grade control drilling will be adjusted over time but could be at a 100m by 100m spacing,

to provide accuracy. However the optimised drill spacing will be assessed once operations have commenced and will be subject to detailed variography[4] analysis. In other offshore mining grade control drilling can be up to two years in advance of actual mining.

47. Grade control drilling will enable TTR to identify any potential areas of minor layers or lenses of mud material that may occur within the proposed mining area that has not been identified with current drilling.

GEOTECHNICAL OPERATIONS

48. Grade control drilling, and other supporting activities to the offshore operation, will require a local support facility to mobilise the geotechnical vessel and its crew. It is critical that a warehouse and wet laboratory facilities, to process and test samples, is in close proximity to the location from which the geotechnical support vessel will deploy from.

49. TTR have identified Whanganui Port as a key infrastructure facility that would be able to provide the resources required to deploy, secure and service the geotechnical support vessel as well as having the warehouse, laboratory and offices required to support this part of the operations.

50. The geotechnical support vessel and the Whanganui Port operations will be used as the "work horse" for the ongoing environmental monitoring, grade control drilling and other operational support required for the offshore extraction operations. TTR and New Zealand Dive and Salvage have used the Whanganui Port facilities on multiple occasions as a base for exploration drilling activities and have considerable experience in entering and existing via the Whanganui River.

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[4] Variography is the geostatistical method that investigates how the variance of the difference of two points, belonging to the same regional variable change with varying separation distances.

CONCLUSIONS

51. TTR has undertaken extensive investigations to define the offshore iron sand resource and through these investigations TTR has been able to:

 (a) Obtain a very good understanding of the physical and chemical properties of this resource;

 (b) Estimate and report a mineral resource; and.

 (c) Develop an initial mine schedule to determine the extraction sequencing of the resource.

Matthew Earle Dunlop Brown